

Mean Results.

	p.	s.	
1883.170	41°43'	9.754	E. Frisly.
1883.211	39°10'	9.260	A. Hall.

Remarks.—The observed conjunctions of the satellites of *Saturn* are with the minor axis of the ring. The wire of the micrometer was set parallel to this axis by means of the angle given in the *American Ephemeris*, p. 479. The conjunction of *Mimas* on October 5 was with the following end of the principal division of the ring.

Note on the Great Comet (b) 1882.

An examination of the nucleus of this comet in the latter part of February 1883, showed two bright points of condensation, with two fainter points, one on each side of the bright ones. These four points were in a right line, and the general appearance was nearly like that given by the drawing of Mr. Prince, *Monthly Notices*, January 1883, p. 85. The following of the two bright points seemed to be the brighter, and calling this point *a*, the other bright point *b*, the preceding faint point *c*, and the following faint point *x*, the following measures were made, the origin being at *a*; *c* and *x* were very faint:—

1883.	Sid. T.	p.	a to b	b to c	a to x	Obs.
	^h					
Feb. 26	6.4	257.2	34.50	47.14	—	H.
27	6.0	258.8	34.58	48.99	22.27	H.

On the Visibility of the Dark Side of Venus.

By Prof. C. V. Zenger.

It is known that the first observation of the Moon's ashy light was made by Michel Maestlin in 1520, but the first observation has been also ascribed to Leonardo da Vinci, who died in that year.

A similar appearance was detected by Riccioli on January 9, 1643, on the planet *Venus* with the then discovered Galilean tube. He says: "Erat planeta Solem versus rubicunda in medio flavescens et in parte a Sole aversa cæruleo-viridis, sed illa varietas a vitro tubi probabiliter fuit." The following passage seems to indicate a very fine state of the weather: "Semi-annulus lucidus, quo a tergo coronabatur, erat forte a *Jove* et *Saturno* illam illustrantibus, utpote orientioribus" (*Almagestum novum*). It is obvious that the reddish hue may have been partly due to the chromatic aberration of the tube, but the

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greenish-blue tint of the dark side was later observed by Harding and Engelmann. Hahne saw it tinted greyish-brown, and Harding also greyish-red.

I could never see the whole dark side myself, and was much inclined to regard these observations as an involuntary illusion, imagination inducing us to complete the partly visible disk, whose circumference is obviously indicated by the part visible on the crescent. Yet there are some observations opposed to this view, by Kirch, on June 7, 1721, and March 8, 1726, when he observed that the dark side seemed a circle of less diameter than that of the crescent. He mentions that he once more saw the entire dark side of *Venus* on October 20, 1759, at noon, although the southern declination of $21^{\circ} 50'$ greatly interfered with a good definition.

Harding made the most trustworthy and accurate observations of any observer, using a large reflector of 10 feet focal length, and a power of 84 diameters. He also saw *Venus* beautifully on January 28, 1806, with the whole aperture of the reflector, and the cusp projecting over the dark side. Another time, February 20, 1806, at $6^h 12^m$, he saw again the entire disk of *Venus*, of reddish-grey hue. Schröter saw, on February 14, 7^h , *Venus* for the first time entire, with the reflector of 20 inches aperture, and 27 feet focal length, in a very feeble light, the hue of which he does not describe.

Gruithuisen, on June 7, 16^h (21 days after conjunction), likewise saw the phenomenon well, though at low altitude.

Finally, Engelmann, on April 20, 1865, Banks, Green, Noble, and Arcimis, 1877, Noble, Mills and Webb, 1878, have seen the phenomenon; but Lassell could not see a trace of the dark side, though he observed with a powerful instrument. This may be perhaps due to the very far advanced diminution of the crescent, which he describes as a hair of light rather than a crescent. The feeble light of the dark side must then vanish, *Venus* being so near to the blazing sunlight; and indeed he says that some days afterwards solar light still invaded the tube and seriously disturbed accurate vision. Though the observers agree as to a greyish colour of the dark side, yet they differ considerably as to the additional tint, calling it reddish, brownish, greenish, ashy, &c. It seemed to me desirable to observe *Venus* after conjunction for the purpose of deciding upon the visibility of the dark side, and the ring, observed solely by Riccioli.

I prepared in the first instance to correct the 4-inch Equatorial I intended to use for the observation as far as possible for all chromatic aberration. A fine specimen of a Barlow lens by Browning was placed in the tube; the objective being slightly under corrected, it was possible to get rid of all traces of colour by placing the Barlow lens in the right position to the objective lens. Trying it on the planet itself till all traces of colour disappeared seemed to me the safest and most expeditious means. It was only in entire darkness that a trace of reddish colour

April 1883.

of the Dark Side of Venus.

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could be detected on the outer edge of the crescent. Aplanatism was nearly perfect.

Prepared in this manner I waited in the discomfoting season of 1882 in vain for a suitable opportunity. Finally, in January 1883, a couple of most splendid mornings favoured us in Prague, accompanied by heavy frost, and no trace of cloud visible all over the horizon. It was possible to set to work at once, and it was first possible on January 8, and then on January 9, between 18^h and 20^h, to see *Venus* beautifully with powers of 60 and 120 diameters, projected on a cloudless dark blue sky.

I did not expect to see such a ravishing spectacle as was disclosed at once to my sight on the 8th inst., 18^h 45^m; *Venus* not only was visible as a whole disk, but there was an amount of detail in the aspect that I believe to be sufficient proof of the reality of the phenomenon. The crescent overlapped nearly 8'' (at least) the adjacent border of the unilluminated part of the disk, the terminator was all along its length serrated, and the reddish-yellow light of dawn invaded the dark disk for at least $\frac{1}{6}$ th of the whole diameter, shading down and fading away on the border of the dark part. This was splendidly visible even to the unaccustomed eye of entirely uninstructed persons, to whom I did not mention the appearance of the planet, but who had seen the Moon as a crescent. They at once recognised the whole disk, well defined and projected on the dark blue sky.

But the most important feature of the observation was the ring, that I could detect all round the disk (dark part and crescent), of brownish-red colour, more pronounced on the illuminated side than on the dark part of the limb, but of a peculiar coppery hue, the close resemblance of which to the coppery hue the Moon's disk assumes when totally eclipsed was very striking.

As it is certain this hue is due to the absorption of the more refractive part of terrestrial light in the atmosphere of the Earth, it seems to me very probable that the reddish-brown ring of light round *Venus* is due to refracted light in the atmosphere, and to the reflected light from the clouds in the planet's atmosphere. Now, supposing *Venus's* atmosphere to be similar to our own, a similar hue by selective absorption must be produced, and the cause of resemblance of the colour of the eclipsed Moon and of the ring round *Venus* is then obvious.

At 18^h 56^m, January 9, I could discern on the southern horn a most striking feature, very near to the end of the southern cusp, which was more sharply edged than the northern one. It was not only indented as the other parts of the terminator, but there was clearly seen an object of perhaps 1'' of diameter standing out boldly in the midst of a more or less greyish-tinted elliptical zone, forming a deep indentation of the end of the terminator. The shading round it was very well visible, and it seemed to me a high mountain of oblong form, piercing with its refulgent light through the surrounding valleys still immersed in half shadow or in full shadow. This is the second time that

I have observed such an isolated brilliant point of appreciable diameter on the southern cusp of *Venus* (*Monthly Notices*, 1877, p. 460).

The dark part of *Venus* seemed to me not bluish-grey, nor greenish-grey; but from the terminator, where the dawning of sunlight produced a pronounced reddish-yellow zone, it faded away to a decidedly reddish-grey tint, bordered by the more luminous reddish-brown of the extremely narrow ring of perhaps atmospheric origin.

We can scarcely imagine a more probable supposition of its nature than a similarity of absorbing power of the terrestrial atmosphere and of *Venus's* atmosphere producing the same coppery hue as is visible on the eclipsed Moon's surface, illuminated by the reflected rays of sunlight from the Earth's surface, and deprived by selective absorption of the more refrangible rays.

Prague,
1883, Jan. 10.

Addition.

It happened that on the 11th and 12th of January, the Moon was a small crescent, and the atmosphere of extraordinary steadiness and clearness, showing the Moon's ashy light with most remarkable clearness, the mountains being visible as I had never seen them before in the dark side.

It was after a most trying period of wet and cloudy weather that the sky began to clear up from the 7th, the 8th being again cloudy, but from the 9th to the 13th there was a singular clearness all over the heavens, there being a deep blue from morning to evening. It was this clearness that obviously increased the visibility of the dark side of *Venus* as well as of the Moon. But it shows also clearly to me the parallelism of the phenomena of visibility of the dark sides of *Venus* and of the Moon. On the 12th, and after, the dark side of the Moon was no longer visible to the naked eye, and it was the same with the crescent of *Venus*. It is only possible to see its dark side to advantage, if:—

1. The atmospheric conditions are exceptionally fine;
2. If a certain part of the disk is only illuminated, and *Venus* is at her greatest luminosity, or near to it, as has just been the case.

There is a certain advantage if the luminous part is not too great, and if it is in its greatest luminosity; the feeble light of the dark side is then likewise at its utmost visibility.

Venus's dark side is therefore visible not by fluorescence of the sea, nor by auroral light, but simply by the same causes as those that make the Moon's dark side visible.